EOS, Transactions, American Geophysical Union

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AMBORAL CONVECTION OVER 50° < 9 < 73°. S. AVERAGE

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Particles and Fields-Magnetosphere

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The question of when the United States would again place man on the moon was the emphasis of three special sessions at the Fourteenth Lunar and Planetary Science Conference in Houston, Texas, last month. There was a hint of credibility to these discussions after an opening address by Hans Mark, Deputy Administrator of the National Aeronautics and Space Administration. Mark noted that the reclimplogy exists to build a space station on the muon and to operate it for a reasonable cost. He noted the scientific advantages, some of which involved obtaining more 'ground truth' on the moon to hum a laris for studies of the solar system. He also touched upon interest in the earth-moon sys-

In an analogy with man's exploration of another hostile environment, Amarctica, Mark noted three phases: 'early exploration, scientific expedition, and establishment of a permanent residence' (Fourteenth Lunar and Planet, Sci. Conf., Special Sevien Abstracts). He gut these ideas, he said from Werner Von Brann. What awaits in the exploration of the moon is for the last phase to be linanced in pan, and initially, by the military, to be justi-fied by scientific goals, and to be sustained in pan by exploration of hunar resources. It is the last of these three phases that received attention in formal discussion. As it turns out, it is economic to transport costly but lightweight fiquid hydrogen to a parking-orbit storage lucility around the earth. It is also economically ellicient to mine payen on the moon and store it in the same earth-orbiting

The short-term objectives of a lunar base are to mine ilmenne oves on the moon, exmact oxygen from them, and use that oxygen with terrestrially therived hydrogen to fuel tockers. The result will be a "Transportation and Supply System Between Low Earth Othic and the Aloon Which Utilizes Linia Herived Propellatus' (H. Criswell, Special Sevien Aleibads). The idea is to build a surprisingly low cost space transportation system in which torkets could be used over again without the

wear and tear of atmospheric re-curry.

The current costs of the Space Shuttle are 30.2 billion to place 100 toos per year in geoynchronous orbit above the earth. One linndred tons of liquid-oxygen projedlant are required. The rockets now used to transfer payload from low earth orbit to geosynchronous orbit are expendable. A rocket Incled in earth orbit could carry much more valuable cargo. After such a link between earth orbit and the morn were established, additional facilities could be transported economically to the moon. Such a system could be rapidly expanded to support a unifor space inclusity. An eventual variation of this theme would employ silanes, the silicon analogs of hydrocarbons. No hydrogen would be required, and almost the entire low-earth-orbit/hunar function could be operated from space.

Facilities on the moon would be automated tomine lunar soils. Various materials could be fabricated and the whole operation energized by solar converters. Such a system could support a greatly expanded shuttle system. Deep space uncrations could be generated on the moon. Criswell, of the California Space Institute, calculates that such a system would not be too difficult to get started. 'The entire initial system, including propellants, could be taken from earth to LEO (low earth orbit[ in one shuttle llight. The lunar-derived propellants might form the first materials inctly off earth which ntilize monterrestrial

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materials, allow continual incremented growth and might be economically compedtive compared to launching the equivalent products from cartle."

L. Haskin of Washington University, St. Louis, has computed that an object must be boosted by about 40 times more energy from the earth to a high orbit than from the moun (Special Session Abstracts). The energy advanttage could make it conceivable that lunar materials could be fabricated and transported back to earth. Even the limited assessments of lunar metals based on observations made thiring the Apollo program suggest that at least Si, Fe, Mg, Al, O, and Ti could be extracted economically. Other possibly extractable elements from the moon include Cr. Ma. S, and P, plus even lesser amounts of C, H. N, and noble gases.

It seems clear the United States can have a can feasibly be established, and the labricaspacecraft, fuels, and equipment for deep tura-to-the-moon project may get priority owing to military considerations. For peaceful scientific or industrial reasons, the return to the moon evidently only awaits the decision to proceed.-PMB

## Isotope Fractionation

A rash of new controversy has emerged around the subject of mass-independent isotope fractionation effects, particularly in the case of the oxygen isotopes. To be sure, the controversy has been around for awhile, but it has been given new imperus by the results of a recent sinds by Mark H. Thierieus and John E. Heidenreich III of the University of Galifornia, San Diego (Science, March 4).

Unistay Arthenius has been riving accomvince the planetary science community that chemical effects in isotope tractionation processes could explain observations in mercorites that appear to be outside of the traditionally understood mass-dependent fractions ations (G. Arrhenius, J. L. McCtumb, and N. F. Friedman, Astrophys. Space Sci., 65, 297, 1974). Robert Clayton had made the basic observations of oxygen in carlomaceous choudrites that the slope of the  $\delta^{17}$  versus  $\delta^{18}$  line was 1 instead of the slope of 1/2 characteristic of terrestrial rocks and limat samples (Ann. Rev. Nucl. Part. Sci., 28, 501, 1978). The

watern component of O 6. The new results of Thiemens and Heidenreich, however, suggest that a superlicial process involving the formation of coone may produce the fractionation. Such a process could be stimulated by ultraviolet emissions from T-Tauri stars, they suggest, affecting all the classes of meteorites. The process could be occurring also in the earth's upper atmosphere, thus potentially affecting oxygen isotope equilibria and interactions on the earth's

How would such a process operate in the workers in the general field of isotope georiment. They started with a sample of an

program to return to the muon. A lunar base tion of lunar materials for the construction of space Hights is rechnologically possible. A re-

Please note: The Proceedings are not included with your

mass-independent effects were ascribed to the apparent contribution of an ancient presolar

penduction of ozone? And why has the process not been suggested before. These are questions that have come to the mind of chemistry. What Thiemens and Heidenreich actually observed was a carefully analyzed exunfractionated mixture of exygen isotopes with, in effect,  $\delta^{17}O = \delta^{18}O$ , held in scaled glass tubing. They produced an electrical discharge are in the mixture with a tesla coil

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held externally to the apparatus, and extracted the resulting ozone for analysis he mass spectrograph. A portion of the extracted ozone was sent to Robert Clayron's laboratory at the University of Ulmrago as an analytical check. The results, when plotted on a threeisotope coordinate system,  $\delta^{17}U$  versus  $\delta^{18}O_{\rm t}$ gave a slope of 1.00 (± 0.01). The correlation coefficient was 399. According to Thiemens and Heidenreich. "Since the effect essentially displicates the isotopic distribution in Carbonaceons chondritic meteorites, we suggest that photochemical processes may have been of importance in the presolar nebula."

The experimental results, if taken at face value, seem to be a valid demonstration than the minimal meteoritic fractionation relations can be reproduced in the laboratory. The mechanisms of the process, however, remain not too well explained so far. The explana-tion favored by Thiemens and Heidenreich is as follows: "We feel that the mass-indepentlent fractionation is a result of optical shielding by the major isotopic species <sup>hOlfo</sup>O, which is more abundant than <sup>lo</sup>O<sup>lf</sup>O and 16O17O by factors of 245 and 1348, respectively." In effect, the vastly more abundant <sup>16</sup>O<sub>2</sub> molecules close to the arc source react to the O<sub>3</sub> molecule [ozone] rapidly, and shield other O<sub>2</sub> molecules along the arc path. Disso-ciations of <sup>17</sup>O<sup>16</sup>O and <sup>18</sup>O<sup>16</sup>O innlecules are

relatively unshielded; the result is the preferential formation of isotopically heavy ozone In the experiments, the chemical steps of preparation of the starting gas, cryogenic ex-traction of the ozone produced, and analysis of the results were done systematically. The physical steps of the electrical-discharge and

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dissociation phenomena, however, were relatively uncontrolled. It was difficult to delimit the physical process that caused the mass-independent fractionation, and thus the results could be more subtle (ban believed by the nyvestigators. Without carefully controlled, systematic measurements of the arc-discharge process, the interpretation can ordy be considered speculation. For example, it may be difficult to explain the shielding process as totally being due to the humed release of alivavioler photons from a typical are produced by a Tesla coil. A more claborate test of the process could email a controlled laser source with the dissociation process sampled at known distances.

Thiemens and Heidenreich note that photo-shielding effects that produce heavy ozone in the stratosphere have been suggested before. There are plans to test the concepts on balloous or other atmospheric study vehicles. They note also that T-Tauri stars coday emin more ultraviolet radiation than does the sun. This result was obtained by means of the International Ultraviolet Explorer (IUE) Mission. It would appear that all components of the postulated process are in place, consistent with the rather extensive geochemical implications that would be true. If the physics of the process can be demonstrated, the geo-chemical and cosmochemical implications will be great indeed.—PMB

## **NSF** Graduate Awards

Of the 450 college students offered fellowships by the National Science Foundation (NSF) this year for graduate steely in 1983-1984 in the natural and social sciences, mathgraduate studies in earth, ocean, or space sciences. None of the 50 science students awarded NSF minority graduate fellowship awards plans to study in the geophysics-related sci-

Each fellowship, awarded for 3 years of graduate study, provides a stipend of \$6,0001 per year for full-time graduate study. An annual cost-of-education allowance of \$4,000 is provided by NSF in lieu of all tuition and less to the institution selected by each fellow for graduate study. The fellowships may be used over 5 years to permit students to incorporate teaching or research assistantships attutheir education during periods in which they are not receiving their followship stipends.

In addition to the NSF Graduate Fellowship awards offered this year, 966 individuals who received fellowship awards in previous years are eligible to continue their study dur-ing the 1988–1984 fellowship year.

Those students who were offered graduate fellowship awards this year to pursue graduate studies in enrth, ocean, or space sciences are listed below with their proposed fields of study and the institutions chosen for graduate study.

News (cont. on p.146)

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News (cont. from p. 145)

Thomas Jishn Algeo, geology, Univ. of Ga.; Teresa Mary Atwill, geningy, Stanford Univ.; Donna Faye Balin, geology, Univ. of Cam-baldge (England); Gregory C. Beroza, geo-physics, Univ. of CaldUCI, Santa Gruz; Graig Richard Bina, genthysics, Northwestern Univ.; Marcia Glee Bjornerud, geothysics, Univ. of Wis.-Madison; Paul Mattir Bodner, atmospheric sciences, Univ. of North Carolina, Chapel Hill; Nancy Ann Breen, geophysics, UC, Santa Cruz; Laureir Shelley Brown, geology, Rice Univ.; Ken H. Croswell, astronomy, Cal. Inst. of Tech. (CalTech); E. Ana Davies, geology, UC, Berkeley; Jae A. Dellinger, geophysics, Mass. Inst. of Tech. (MIT); Pamela i.ynn Earl, meteorology, Univ. of Wis.—Madisen; Richard Joseph Ebton, astronumy, CalTech; Lind Shelmertline Gee, geophysics, MIT; Lisa Estelle Harstad, geology, Univ. nf Ill., Urbana-Champaign; Robert J. M. Hudsen, engineering and environmental sciences, MIT; Susanne Ussrda Janecke, geology. Univ. of Ariz.; Pamela E. Janunia, geology, Northwestern Univ.

Bradley Loring Juliff, geology, South Dakota School of Mines and Technology; David Wayne Jurgensen, geology, Penn. State Univ.; Juhn Paul Kaszuba, geology, Vo. Poly. Inst. and State Univ. [VPI&SU]; David John LePuire, armuspheric sciences, MIT; Jerry F. Magloughlin, geology, Univ. of Wash.; Yvonne Juyce Meeks, genultysics, Stanford Univ.; Ronald Lindsay Miller, meteorology, MIT; Hugh Falward O'llrien, geology, Univ. of Wash.; Joseph Richard Pawlik, hit-ocean-ography, UC, San Diego; English C. Feorcy, geology, Stanford Univ.; Lisarne Gale Pearcy, geology, Stanford Univ.; Cardyn Rose Rebbert, geology, VPL&SU.; Barbara Sue Ryden, astronomy, Univ. of Chicago: þelm Francis Saponara, earth science, ÚC., Berkeley; Daniel David Schelling, geology, Univ. of Colo., Boulder; Elizabeth R. Schermer, geology, UC, Santa Baibara; Kasen Rae Schmitt, geology, Columbia Univ.; Linda Stathophos, bio-oceanography, Univ. of

**Books** 

Desert Dust: Origin,

Characteristics, and

Spec. Pop. 186. T. L. Pewé (Ed.), Geological Society of America, Boulder, Colo., x + 303

This volume is the result of a 1977 sympo-

sium convened in Denver, Colo., by the edi-

tor nunler the sponsorship of the Committee

on Arid Lamls of the American Association

volved in the presentation of 15 papers, 11 of

which appear in the volume. Ten other pa-

pers not presented at the meeting were sub-

sequently added. The 303 pages are well il-

lustrated with about 225 figures and tables.

The papers cover an enormous range of phe-

nomena, from transport of dust globally to

transport of dust from abandoned farms to

adjacent highways. It even contains one pa-

per un Martian dust movement bin it is not

interplanetary, although the editor's preface

The book is divided into three groups of

papers: 'Origin and Transportation' (plus

meterisological requirements), 'Characteris-

tics' and 'Effect on Man.' (Many of the au-

thors implicate man as a major cause of dust movement; hence, 'Effect of man' might be

an equally appropriate title for the third chapter. The first and last sections are each

represented by nine papers, but the section un 'Characteristics' contains only two, both of

which could have been included in one of the

other sections. The book thus really divides

and the second with the effects on man main-

Péwé introduces the valume with an excel-

lent summary discussion of desert dust. It is

well organized, comprehensive, and provides

the reader with a broad appreciation of the history and problems associated with dest

In the lirst paper of the first section, Gil-

lette discusses dellation and transport in the

quantitative lumidation to the more descrip-

Jackson, is a suphisticated attempt to establish

tradition of Bagueld and gives an excellent

tive articles that follow. The next article, b

the world-wide provenance of transported

dust, mainly by the use of oxygen isotopes

(()18/()14). The article by Rahn and others

concerning Asian dust over Alaska rambles

but provides important information about the effect on the Alaskan almosphere of material transported across the Pacifiq. The sulhors

clearly differentiate between Arctic haze caused by pollution and the sporadic intru-

sians of Asian desert dust. These phenomena

are important to understand because of their

effect on radiation balance at high latitudes. I would have placed this article after the de-

neatly into two parts: the first concerned mainly with long-distance transport of thist

ly in the southwestern United States.

of Science. Twenty-four authors were in-

Effect on Man

Reviewed by David W. Folger

pp., 1981, \$30.00.

R. I., Narragansett; Stephen T. Sutton, geo-physics, Univ. of Mich.; Andrew James Tom-linson, geology. Stanford Univ.; and Howard Jay Turin, geology, Univ. of Ariz.—BTR

# **NATO Postdoctoral Fellows**

Three of the 50 people receiving North Atlantic Treaty Organization (NATO) Postdoctoral Fellawships in Science will study geophysics or a geophysics celated discip The fellowships, announced by the National Science Foundation and the U.S. Department of State, are awarded to young scientists for full-time postgraduate study abroad at institutions and laboratories in NATO countries or in countries that cooperate with NATO.

Gordon N. Shudofsky, currently studying

at Princeton University, plans to do geophysics research at the State University at Utrecht in The Netherlands. Hsuch-tze Lee, currendy at the Woods Hole Oceanographic Institution, will study biological oceanography at the Station Zoologique, France (Villefranch-sur-mer). Charles D. Whiteman, now at the Battelle Pacific Northwest Laboratory, will study atmospheric sciences at the University of lnusbrnck in Austria.

The 50 NATO fellows, selected by the National Science Foundation from \$50 applicants, will receive a stipend of \$1,500 a month for up to 12 months. In addition, dependency allowances and limited allowances for round-trip travel will be provided.

## Geophysicists

Richard Corrigon, former program director for atmospheric chemistry in the National Science Foundation's (NSF) Division of Atmospheric Sciences, has been appointed senior science associate of the atmospheric chemistry program. Jorvis Moyers succeeds Carrigan as ospheric chemistry program director.

tailed studics by Liu and others and by Yang and others of a dust fall that took place in

Beijing, China, during April 1980. The de-tails they presented would have provided a

from Asian deserts to Alaska. In their intro-

iluction, Liu and others note that "The earli-

est known record of "dust rain" [in China]

was that which occurred in 1150 B.G. ...;

long-distance dust movement.

this should give contemporary workers a per

The transatlantic dust-transport story is

well handled in two articles, one by Prospero

and the other by Schutz and others. Prospero

istics, concentrations, and, by means of satel-lite imagery, the track of Saharan dust across

the Atlantic. He expands this discussion to in-

clude concentrations of dust that have been

sampled extensively from ships in the Atlan-tic, Pacific, and Indian Oceans. Schütz and

others focus entirely on tropical North Atlan-

tic dust transport, presenting a good summary of past work that leads them to the devel-

opment of a new, moce sophisticated dust-

meteorologic information the authors con-

clude that estimates of the Atlantic dust bur-

den will have to be revised upward. They also

predict fallout ranges for certain size classes

that will be useful to marine sedimentologists

tian dust stoms is fascinating, but has little relation to a volume predominantly con-

cerned wide the effect of dust on man. How-

ity and atmospheric conditions may result in

new approaches to studying movement of our

The long article by McCauley and others

The authors document, by the use of GOES-

I satellite images, the movement of dust in

February 1977 from areas in Colorado-Kan-

scaboard. Such transport was well known es-

pecially during the 1930's when, for example

York State. However, the documentation of

red dust fell several times on snow in New

source areas, climatic conditions, and trans-

port tracks of plumes for this 1977 storm represents a significant contribution to our

knowledge. Of pardcular importance were field observations by the authors in areas of

deflation, revealing that as much as 1 m of

topsoil was lost from some plowed fields.

The two ardcles in the second section of

the book deal mainly with components that

make up a small percentage of the dust. Péwé and others studied dust that fell from April

1972 to July 1973 on the cedar-shingled roof

sedimentation rates and dust-cloud composi-

tion on the material washed from the roof.

Whether their samples represent the actual

of a house in Tempe, Arizona. They base

sas and Texas-New Mexico to the eastern

courld have served very well as the transition

to the papers concerned mostly with drist

storms in the southwestern United States.

TESTTIAL dayer

ever, some of the techniques being devised to simulate dust movement under Martian grav-

The article by Greeley and others on Mar-

transport model. By integrating detailed

esents a good description of the character-

pective of the heritage of man's concern with

nice springboard from which to introduce the movement of dust over even longer distances Gordon P. Eaton has been appointed provost and vice president for academic allans at Texas A&M University. The former dean of the geosciences college has been at the university for 2 years. Previously, Eaton had been associate chief genlugist of the U.S. Geo-logical Survey in Reston, Va., and the scienist-in-charge at the Hawaiian Volcance (Beer-

Charles L. Holser, professor of meteorology and dear of the College of Earth and Mineral Sciences at The Pennsylvania State Univer sity, was recently elected chairman for 1981 of the board of trustees for the University Corporation for Atmospheric Research

Ludwig F. Oster, formerly a professor in the department of astrophysical, planetary, and atmospheric sciences at the University of Golorado, Boulder, has been appointed pro-gram director of the National Radio Astrono-Observatory (NRAO) astronomy center section of NSF's Division of Astronomy.

As part of the National Society of Professional Engineers' (NSPE) scarch for the Federal Engineer of the Year, federal agencies are requested to select from among their ranks an engineer of the year. This year 27 agencies entered candidates. Among them are two AGU members: Chih Ted Yang, 1.F., the Engineer of the Year at the Bureau of damation, and James P. Bennett, P.F., Engineer of the Year at the U.S. Geological Survey. An engineer from the David W. Taylor Naval Ship Research and Development Center was selected Federal Engineer of the Үеат.

#### In Memorian

The following AGU incinbers are recently

Frank Dochille, 65, died February 28, 1983. A member of the Planetology section, he joined AGU in 1977.

Stuart W. Grinnell, 73, died in Nuvember 1982. A member of the Hydrology section, he joined AGU in 1987.

# Forum

## Registering **Hydrologists**

A nation with attempt is being made to nomate an argamization which calls its American Institute of Hydrology which will register hydrologists. The announce ment which was onculated mentions that mavision is being made that those requanting paice to June 30, 1983, will no be required to take an examination poor tu registratiogr.

While the undersigned are not necessaily taking issue with the general concepted registration, we do object to what appear to be the almost total lack of involvement of the profession as a whole in the planring and execution of this process. Take valid, sin ir artion needs the considered advice and active involvement of representatives from the American Geophysical Union, American Society of Civil Engineers, Gordogical Society of America, American Water Resources Association. and all other organizations in which he drologists make up a significant musler

Michael D. Bradby, Nathan Burg, Donald R. Davis, Stanley N. Davis, Luon Duckstein, Judith M. Dworkin, Since Ince, Thomas Maddock, III, Shloms P. Neuman, Engene S. Simpson, Soroob Sequestrian, Glenn M. Thompson

Department of Hydrology and Water Retigon College of Earth Science University of Account, Turson, AZ 85721

Doe B. Kriogeld, Stt. died on March 2. 1983. A Life Member of AGU, he joined by Hydrology section in 1935.

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Publisher: GEOPHYSICAL PRESS

dust clouds is open to question because windy conditions which often accompanied the dust falls may have resulted in selective winnowing or nondeposition of certain constituents. The main thrust of this article is that desert dust contains a small percentage of CaCO3 and MnO and that these constituents account for much caliche and desert varnish, respectively. Callebe probably is important because it atfects ground-water percolation, but the geo.

logie significance of desert varnish. than as a climatic indicator, escapes in the second article, Leathers describe the plant components of Arizona dust, the messignificant of which, apparently, is the first Coccidioides immits which causes Valley from a sometimes form

a sometimes fatal disease in humans.

The two articles by I do that lead the section are interesting because of their applicability and because they both are our applicability and because they both are our

ously highly controversial. In the lirst article, the author takes aim on the long-held view that particulates in the atmosphere ranse climatic cooling due to reflection of incoming solar radiation. With support from a number of studies, including his own, he argues that particulates in certain concentrations in some areas actually produce atmospheric warming instead of cooling. Thus warming of the atmosphere by an increase in CO<sub>2</sub> may actually be enhanced in the presence of moderate levels of particulates. The second article clearly points out that man may cause increased aridity and dust transport through overuse. and overgrazing. Letting areas return to a natural state may well reverse such trends. A short paper by Shikula which describes dust-storm initiation in the South Ukraine, USSR, is tucked in among the rest of the papers in this section. The author uses his data to clevelop a predictive model that relates which speed and moisture delicit to thist-storm initiation. Two papers by Nakata and others and by Wilshire and others describe dust-storm activity in California. The liest documents dust movement in the Mojave Desert and the second describes the effects of an extremely violent wind storm on the San Juaquin Valley, where winds apparently attained velucities of 300 km/h and eroded soil to depths of at least 75 cm. Even more dramatic was the erosion to depths of 35-40 cm by sand blasting of coarse-grained granite bedruck; this clearly demonstrates the damage that such storms can do to structures, not be mention people. Fryear, in an article concerning loss of soil productivity, alerts the reader to the many factors, in addition to wind erosion. that may result in a decline of crop production such as loss of natrients by crapping, in-

The Beekly Newsjaper of Geophysics

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aver. Cross section of a frazil ice dam.

Picture was made at 10:50 A.M., January

Glen Isle Resort on the North Fork of the

South Plane River, Park Gounty, Golora-

ground water recession from the natural

slush forms in streams and may attach it-

self to stream banks to form slabs of ice.

With the distrnal fluctuation of air tem-

orm short-lived dams. The photograph

dam, probably formed in late December 1982, consisting of fragments of ice slabs in a matrix of frazil slush. When first

ormed a very small percentage of frazil

sitish consists of ice. When an early winter

ice jam forms it usually remains in contact with flowing water. Upward migration of water into the frazil stush fills the yolds.

and in time the porous dam turns into sol-

broke, the cross-section, estimated to be

about I m deep, was left above the flow-

U. Garsika, 215 Louis Rd., Bailey, GO

ing water level. (Photo courtesy of Walter

100

id ice. When this temporary ice claim

shows a remnant of an early winter ice

perature, slabs usually break loose aird

do. The streamflow consisted of only

drainage basin. In early winter, frazil

16, 1983, about 0.5 km upstream from

oum use. Permission is also granted to use short quotes and ligures and rables for publica-tion in scientific books and journals. For peruls-sion for any other oses, canact the AUU Publi-

Officers of the Union James A. Van Allen, President; Charles I., Drake, President-Elect; Leslie 11, Meterliit,

spaced manuscrim to Eac.

# **18th General** Assembly of IUGG

elling studies...

D. W. Folger is with the U.S. Geological Survey. Woods Hole, Mass. DELEGATES

U.S. scientists planning to attend the 18th General Assembly of IUGG, Hamburg, West Germany, August 15-27, 1983, should notify A. F. Spilhaus, Jr., Secretary, U.S. Nation al Committee, 2000 Florida Avenue, N.W., Washington, D.C. 20009, and Indicate in which IUGG association they propose to participate so that they can be officially designated as delegates from the United States.

sects, soil-borne diseases, and water erosion

The section's final three articles mainly

highways (Hyers and Marcus, Burrin and

lde for the storms (Brazel and Hsu). The

studies include photos of multiple car accidents where visibility was abruptly reduced

due to dust storms associated often with

illunderstorius. Much dust deflates from

also transported long distances from the

abandoned larms near highways, but much is

monnains of north-central Mexico, the Mo-

gollon rim in Arizona, and from Galifornia.

Editing throughout the book is good; one or two typographical errors per article is

alient average. A few major glitches gave the

reader a respite from an otherwise 'dry' sub-

buildup was due to the burning of fossil mod-

In summary, this volume contains some ex-

ject. For example, 'Numerous investigators have documented that the carbon dioxide

cellent, comprehensive articles concerning

long-distance dust transport. It is definited

chemistry. However, the section on the 'Ef-

lects on Man' presents some striking clocu-

mentation of the damage caused by recent se-

vece thist and sand storins. These suidies also

highlight the advantages and use of satellite

imagery to detail the erosion, transport, and

deposition of desert dust.

short on details of dust constituents and

Hyers) and the climatic conditions responsi-

concern hazards due to dust on Arizona

# TRACERS IN THE SEA

WALLACE S. BROECKER Lamont-Doherty Geological Observatory

Tsung-Hung Peng Oak Ridge National Laboratories

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Teaching responsibilities include advising, instructing undergraduate level course descriptive of
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drainage systems, and another in drainage system
design. At the graduate level, a course in groundwater flow is required. Research in the detailed processes occurring in shallow groundwater is expected
to provide management alternatives and drainage
design criteria for cropped areas and for drain water reuse.

design criteria for cropped areas and for drain water reuse.

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Biometeorology/University of California. The Department of Land, Air, and Water Resources, University of California, Davis, automices a pusition in the area of biometeorology. Tenure track of months) position will be divided 50% reaching and 50% research. The appointment will be at the Assistant or Associate Professor level, depending on qualifications.

sistant at Associate Professor level, depending on qualifications.

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in general areas of atmospheric science, and advising responsibilities.

APPLICANTS: Applicants should submit curriculum vita, transcript, statement of research and teaching Interests and background in each, copies of publications and maustripts and the names and addresses of at least three references to: R.H. Shaw, Chair, Scarch Committee, Department of Land, Air and Water Resources, 177 Hongland Hall, University of California, Davis, GA 95616, no later than June 15, 1983.

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University of South Florida

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Research Position/Space Physics. The Space Physics and Astronomy Department at Rice University seeks applicants for one or more full-time research positions within the department. Successful applicants) will play key role(s) in the development of theoretical three-dimensional mulets of the Earth's electronagnetic field. Applicants should have knowledge of, and intorest in, at least one of the following areas: solar-wind magricosphere interactions, magnetosphere-lonosphere coupling, ionosphere-atmosphere coupling, atmospheric electricity. Experience and/or interest, in numerical modaling is an important consideration.

Title and salary level commensurate with experience, ranging from one-year Research Associateshlp (renewable in subsequent years depending on peformacce) to open-ended Research Scientist appointment in the Center for Space Physics. Please send resume and manes of three professional references to T. W. Hill or R. A. Wolf, Space Physics and Astronomy Department, Rice University, Houston, TX 77251.

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ographier with a general background in nearshore processes with emphasis on field and remote sensing investigations of surface gravity waves.

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D. L. Inatan, Director, Center for Coastal Studies A-009, Scripps Institution of Oceanography University of California-San Olego

La Jolla, CA 92093.

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Chairman—Oppartment of Geological Sciences, Wright State University. The Department of Geological Sciences, invites applications for the position of chairman, to be appointed September 1984. We seek a dynamic individual with administrative talem and an appreciation for cesearch and practice related educational activities. Rank is on the full professor level and no restrictions have been placed on areas of specialization. The department is active with 12 faculty and an emphasis on professional practice, yet maintaining a limi commitment to basic research.

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Dayton, OH 45455.
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Two Tanure Track Fasulty Openings in the Cossisland Oceanographic Englinearing Dapartment/University of Florida. Applications are invited for faculty positions in the area of oceanographic engineering. Candidates about the area of oceanographic engineering. Candidates about the area of oceanographic engineering. Candidates about the order of the following areas is highly desirable: Difshore engineering, marine structure design, materials in matine environment, temote sensing applications and laboratory and numerical modeling of coastal, bay and returnine environment. Other specialies in coastal and oceanographic engineering will also be considered. Ranks (professor/assoriate professor/assistant professor) and salaries commensurate with qualifications. Anticipated starting date of August 5, 1983. A detailed resume, academic transcripts and three letters of recommendation should be sent to: Dr. M.R. Ochi, Search Committee Chairman, Cossida and Oceanographic Engineering Department. and Decanographic Engineering Department.
336 Weil Hall, University of Florida, Gainerrille, FL
326 H. Pustmark before June 30, 1983 deadline.
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Mesoscale Rasearch Section of the Atmospheric Analysia and Prediction Division (AAP)/Ph.O. Selentisi I or 11 (Two Positiona). The National Genter for Atmospheric Research in Bouhler, Colorado is recruiting for Scientist I or 11 in do lastic research studies on small-scale or mesoscale meteorology. The research will be selected and defined in collaboration with the senior staff. The primary emphasis will be in advancing the fundamental understanding of important mesoscale processes and their interactions with smaller scales of notion. Both the original and observational studies will be encomporcical and observational studies will be encour-aged; the maio goal is to improve the skill of meto-

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- Demonstrated skill in effective written and oral communication

  Strong mathematical fan kground
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# Canadä

Research Positions for Mathematical
Physicists. Applications are invited for several research positions at the Center for Studies of Nonlinear Dynamics, La Jolla Institute, beginning summer 1983. Current research involves work on nonlinear ware-ware interactions, accounte, opiral, and radio wave propagation in random uncita, and lineuration phenomena in the statistical mechanics of chemical and geophysical system. Physicists and applied mathematicians who are interested in working on problems of the above type should send resumes and arrange for three letters of recommendation to be sent to Dr. Stanley Flatte, Oitector, CSND, La Jolla Institute, 8930 Villa La Jolla Orive, Smite 2150, La Jolla California 92037.

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Temporary Position: Igueous Petrology and Geophysical University of Montana. Applications are invited for one subbatiral replacement at the instruction of assistant professor level for winter and tyring quanters of 1983–84 academic year. The period of romatest obligation will be approximately January 3, 1984 to June 8, 1984. A graduate suident who will have completed a doctorate below September 1983 or amicipates completion sometime during the period of emphatical would be approximent for this division.

The Department is looking for sometime to reach undergraduate igneous periodox and pethaps a course in geophysics. The average department course load per quarter is two courses.

The position is replaining a faculty member our substantial and therefore is not permanent or on a tenure track. To apply send a resume and two letters of tecommendation to: Arnold J. Silvetman, Chairman, Department of Geology, University of Montana, Missoula, MT by May 15, 1985.

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Ceological Oceanographer/Humboldi State
University. One year temporary position beginning I September 1993 in Oceanography Department for a geological oceanographier. Preference given to cambidates who hold Ph.O. in geological oceanography and have teathing experience in the understaduate level. Primary teaching tesponsibilities include offering courses at the uniletyraduate level in Gerilogical Oceaningraphy, Marine Sedimentation, Beach and Neurobeal Primary Aurine Sedimentation. level in Geological Occampraphy, Marine Sedimen-tation, Beach and Neatshore Processes, General Occampraphy and Resources (non-living) of the sea. Additional responsibilities imitude advising sen-lor students with their Senior Research Projects and participating in the Senior Druise. Candidates who are not registered with a placement office should so-livit three feners of recommendation from persons familiar with their professions! preparation and experience. A summary of personal and profession-al itars and a transtript of academic work are also caudified candidates should be senior.

reuited.
Qualified candidates should have their letter of application and professional papers sent by 15 May 1983 to Dr. Richard L. Riderthour, Dean, Cullege of Natural Resources, Humbuldt State University.
Arcata, 12. 85521. Telephone (707)826–3561.
Humboldt State University is an equal opportunity employee.

Research Associate/Space Physics. Applications are invited for a research associate to assist in the analysis and interpretation of data from a network of midiatinude magnetometers with special emphasis on geomagnetic pulsation and substorm studies. The position is available September 1984 and is for a period of two years.

Ph.D. and a background in magnetosphede physics required; experience with time-series analysis an advantage.

Send resume bibliomer

Avantage.

Send resume, bibliography and the names of three persons from whom recommendations may be obtained to Dr. W. Hughes, Astronomy Department, Boston, MA 02215.

Boston University is an affirmative action/equal constrainty employer.

Graduate Research Assistantiships. The Department of Geology at Sul Ross State Patientsity autoripates the availability of graduate research assistantihips to students interested in the AIS program. Research areas will include: mineralogy, periology and geodogy, patients to geology, patients and geology, patients and property and paleocevironments. Appaintments are half-into-with a maximum supend of \$5,000 and waiver of out-of-state tuition.

Applicants should submit a letter of application stating research interests along with a transcript and two letters of recommendation to: Dennis Nelson, Chairman, Geology Department, Sul Ross State Purcessiv.

Chairman, Geology Reparament, Sal Ross State Pro-versity, Alpine, TX 79832.

Problem in Physics Department. Resembly of from item area of space and been plasmaphsowith emphasis on innecessal smulaion is additionable this fall at the University of Texas, Anomalius and rights and rapid space plasma physics group of the Texam with the tusion plasmaphysics group of the Texam with the tusion plasmaphysics group of the Texam with the tusion beautifus and rank depend on qualifications as so taken with 118 new be actained upon qualifications. Send resinue to:

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# Supporting Members

The fullowing individthe list of Supporting Members. The full list was last published in the November 30, 1982, Eas and updated in the Jan-uary 25 and March 8, issues.

GIFT

Life Supporting Member Paolo Lanzario.

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# Membership Applications Received

Applications for membership have been reived from the following individuals. The letter after the name denotes the proposed primary sortion alliliation; the letter A denotes the Atmospheric Sciences section, which was formerly the Meteorology section

Regular Member

Roger Allen Bauer (O), Rex J. Fleming (A) Paul C. Katen (A), Richard Katelmani (H. Patricia Lennard-Muyer (11), Elable Manho (A), William Menke (S), Aristides A. Patriss (A), H. Denu Pilkington (V), James D. Spir hirne (A), Margaret St. Peters (GPI, Ofe-Steeher (V). Lother Stramous (O).

Student Member

David B. Cuddington (A), Marie C. Color (O). Christopher Candit (V), James F. David Karen M. Fischer (S), Efi Foufoula (H), 100 Fuurnelle (V), Ruger H. G. M. Francol Pete Geddes (VI, Joseph Greenberg (S) As-bertu E. Guinand (H), Sid Halsor (VI) Kruger (T), Steven Lnar (T), Khilifa Manar (H), Ben G. Marsden (Pl. Rubert Mc abs. Paul Newman (A), Raper H. Pago220 Paul Newman (A), Rence H. Paoozzo (B), Robert Provinces (P), Jenn-Vih Penk (S), Deborat Provinces (V), Claudio Soliazzo (M), Michael D. Soliazzo (V), Claudio (V), Clau Michael D. Sweeney (O), Tswen-Yung Michael D. Sweeney (O), Tswen-Yung Michael D. Sweeney (O), Tswen-Yung Michael (S), John R. Webser (C), Steven Ward (S), John R. Webser (Michael Mark A. Williams (A), Mary Leigh Wolfe (Michael Mark A. Williams (A), Mary Leigh Wolfe (Michael Mark A. Williams (A), Mary Leigh Wolfe (Michael Michael Michael Michael Michael Michael Michael Michael Michael (Michael Michael Michael

Associate Member

Margaret R: Condon (H), Karen McGall ery O. Will M. Ollson (A), Henry Penne

# **Meetinas**

Ahoy! Sall Back Into Baltimore

for the 1983 AGU Spring Meeting

May 30-June 3

### Session Highlights

Union

History of Geophysics Wednesday A.M., Room 305. A paper reviewing theories of the physical and chemical structure of the Earth's core will follow the Volcanology Session on Xenolitis and Kimberlites on Weilnesday morning. This should be of broad interest to many AGU members.

Satellites and the Geosciences Wednesday all day, Room 317. This session reviews past and current use of satellite tlata in the genstiences and analyzes potential future developments. The requirement for observations is common to all the geosciences. The advent of satellite observations began a revolutionary change in the data available for research on amospheres, the oceans, and, to a lesser extent, the geology and geophysics of the solid earth and planets.

For research on planetary atmospheres, induding the earth's upper atmosphere, observations from satellites providing close or in sau measurements now greatly exceed those made by ground-based remote sensing from earth. Ocean observations from satellites have shown that global data of value to physical and hiological or ranography can be received. There has been considerable use of LAND-SAT data for geological interpretation; roller space oriented techniques, such as VLBI and saellite geodesy, have proven important for

geodynamics and geodesy.

Verification of Nucleae Test Bans Thursday. all day, Room 317. This year is the 20th anniversary of the Limited Test Ban Treaty, which banned atomic testing by the signatories in the atmosphere, means, and space but not underground. A Lomprehensive Test Bau Treaty incholing explosions in all envirounients has been one of the longest sought goals of arms control but is still not a reality. laterest in a comprehensive test ban has increased in the United States sharing the last year as public interest in arms control and ing undear war has increased.

In July 1982 the United States government announced that it would not continue trilateral talks underway from 1977 to 1980 on n comprehensive (teaty arguing that (1) seismic methods are not good enough to verify compliance, (2) the USSR may have repentedly violated the 150 kilotun limit on underground esting set by the Threshold Test Ban Treaty of 1976, and (3) there is a need to continue nuclear testing. Seismulugical research un verifying test bans has been underway in the United States for 25 years. This symposium will address several key issues involving the interaction of geophysics and public policy: Can a comprehensive test ban be verifical and with what reliability; what are the most reliable methods for estimating yields of underground explosious; have the USSR and the United States complied with the terms of the Threshold Treaty?

### Atmospheric Sciencea

Ocean/Climate Interactions In the Pacific Wednesday P.M., Rama 321. At intervals of 3 to 6 years widespread anomalics in sea-surface temperature and sea-level are observed in the equatorial Pacific. The events are assiciated with the El Niño (Christ-child) phenumeria that develops along the Pernyian Coast and disrupts lisheries, bird-life, and the weather in that region. It also profoundly alfects weather throughout the tropical Pacific and appears to cause rhanges in climate in many areas of the globe, including North

The Equatorial Pacific warming of 1982

was one of the most intense ever observed and the apparent ronsequences have been spectacular. This special session, cosponsored with the Oceanography Section, will analyze the development of the 1982 event, compare it to others such as those in 1976 and 1972, and speculate on its future evolution. A major scientilic issue is whether the event is set into motion by an oceanic or annospheric trigger. The session will probably stimulate considerable speculation about the linkages t the serious drought in Australia, the unusual ferocity of winter storms in California, and the mild winter over most of the United States. Study of this phenumenon promises the first breakthrough in the search for a physical basis for predicting seasonal and international dimate fluctuations.

New Observing Systems for Weather Pre-diction Thursday A.M., Room 321. Exciting new measurement technologies are whening the apperites of research meteorologists as well as forecasters. These technologies promise unparalleled ability to observe the atmosphere and severe weather in time as well as in space. Most of them remotely measure atmospheric properties very rapidly over large solumes. Several share such characterisms as high data rates and high cost. Evaluation of the potential benefits of these new weather observing systems will be a key issue in this special session. Whether to employ new Doppler radars and lidars, sounding systems. and satellite sensors in operational forecasting are billion dollar decisions. They will not he made lightly. Informed judgments by the scientific community must be merged with operational requirements. A proposal for a Varional STORM (Summscale Operational and Research Meteorology Program will be discussed as a means of advancing short-term Interests of significant weather through open aional deployment of new technology guided by a strong research thrust.

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HOUSING DEADLINE, APRIL 25

Solid Each and Ocean Tides Tuesday A.M., Room 321. This session is designed or provide a discussion on the role of tidal analysis and observations in the context of current programs in geodesy and geodynamics. The session will span the wide range of tidal work from a general discussion of the expected contribution of tidal observations toward our understanding of the solid earth to techniques for improving the quality of the measurements. The computation of ocean title models is reviewed and existing models are compared with early other as well as with obsecvations of Lageos and the muon. Applicancean luading effects is also presented.

Earth Rotation and Orientation: Results Tuesday P.M., Room 304. This session will be a forum for earth orientation results, their interpretation, and their rule in earth dynamics. Topics include new measurements from several techniques. Chandler wobble studies. and the exchange of angular minnermum between the atmosphere and the earth. Discussion of earth rotation error sources and their effect on baseline measurements will be presented.

MEETING

May 30-June 3

### Future Trends in Space and Terrestelal

Geavity Measurement and Analysis Il'ednesday A.M., Room 319; Friday A.M., Room 319. Both parts of this session are designed to promote discussions of new gravity measuring techniques. The scope of these sessions includes the presentation of both the insuramentation and methodology of analysis. The impact of future missions, such as TOPEX and GRM, an gravity interpretation will also be discussed.

The Wednesday session will concentrate on satellite- and aircraft-based gravity gradiometer systems and on satellite-tu-satellite tracking, with particular emphasis on the Geopotential Research Mission (GRM). The Friday session session will deal with the recovery and interpretation of geopotential signals obtained through satellite altimetry.

Detection and Interpretation of Crustal Movements Thursday all day, Room 319. The morning session will leature papers on terrestrial geodetic measurements and data interpreration. Strain accumulation and release in California will be emphasized with particular focus placed on the temporal and spatial patterns of horizontal and vertical movements. The afternoon session is devoted to gradetic measurements via space techniques. Current results on regional, inter-, and intracontinental deformations will be highlighted. Future measurement campaigns using VLIII, Laser, and GPS techniques will also be discussed.

#### Geomegnetiam end Peleomegnetiam

Magsat Studies: Fleld Modeling, Secular Variation and External Fields Monday A.M., Room 309. Will describe the latest level in analyzing magsar data in regards to producing new field models accessing the circular variations and determining the influence of external helds.

Geological Interpretation of Long Wavelength Magnetic Anomalies Mundos P.M. Room 302. Recently both extensive aeromagnetic satellite waves and surveys have enabled large scales regional anomaly maps to be produced. The results from Canada, Africa. Amanica, and North Atlantic will be disvissed together with petrological and infineralogical models for these long wave features. Paleomagnetism of Sediments and Sedi-

mentacy Rocks Incides A.M., Room 303. The Deep Sea Driling Project Hydrologic Pision Corning program has obtained cores of long-undisturbed oceanic sediments. Paleomagnetic stratigraphy of these tores and related palennagnetic sedimentary problems are highlighted from diverse geologic set-

Paleomagnetic Results: Archean to Cretaceous Tuesday P.M., Room 303. A nearly complete series of papers describing palenmagnetic results from the archean to rrete-ceous are highlighted. Results are presented

from the major and global aspects.

Magnetle Field Reversals and Plate Mo-Hons Wednesday A.M., Roum 321. The exact heliavior of the magnetic field reversal will be discussed and updated mechanisms for rever-sal presented. Motion pictures of computer miniations of plate motions in the northeas pacific will be slimwn; also, recent studies of microplate activities will be presented.

#### Oceanography

Absolute Sea Surface Temperature Meaements from Satellilea Monday A.M., Room 317. Recent measurements with passive. multihand radiometers aboard satellites have provided data which may be used to determine sea surface temperatures to accuracie uf 0.5-1.0°C. Papers in this session will dis-cuss these techniques using that from both the AVHRR and the SMMR. Invited talks will be given by R. Bernstein, O. Brown, and E. P. McClain.

Gulf of Maine and Georges Bank Monda P.M., Room 307. This half-day session will include the following invited talks: B. Magnell, 'Response of Georges Bank and the Gulf of Maine to Wind Furcing'; D. G. Wright and J. W. Loder, 'Theoretical Investigations of Residual Currents over Geueges Bank'; and W. S. Brown and N. R. Pettigrew, The Rela-tion of the Pressure Field Response of the Gulf of Maine and Adjacent Shelf and Atmospheric Forcing. Results from STACS Tuesday P.M., Room

307. STACS (Sub-Tropical Atlantic Climate Study) is an observational study alined at determing the large-scale fuxes ul heat, momentum, and those in the subtropical Atlantic Ocean, Processes occurring in the Florida Straits have been a focus for this program during the last lew months. Papers in this session will present results from several invesugators participating in STACS. Invited talks include Measurements with Moored Stations and Acoustic Ship Profiles in the Florida Culrent, by F. Schou; 'Transport Variability in the Florida Current Determined from Observalions of Absolute Velocity, by K. Leaman and R. Molinari; and Electromagnetic Trans port Measurements of the Florida Current,': by J. Larsen.

#### AGU CHAPMAN CONFERENCE **ON MAGNETIC** RECONNECTION

October 3-7, 1983 Los Alamos, New Mexico Convenor: E. W. Hones, Jr.

Abstract Deadline: July 1, 1983

Invited and contributed papers

Theory of Reconnection

- Computer Models of Reconnection
- Reconnection in Earth's Magnelotail Reconnection at Earth's
- Magnelopause
- Reconnection in Laboratory
- Reconnection in Astronomical Objects

March 29, 1983

Contoct: AGU Meetings: 2000 Florida Avenue, N.W.

Washington, D.C. 20009 (202) 462-6903 D.C. area IoII free 800-424-2488 Call for papers published in EOS.

Trace Element Equilibria/Disequilibria Thursday P.M., Room 307. Models and observations of trace element equilibria/disequilibria in marine systems will be discussed Specific topics include trace metal speciation models, modeling of metal complexation by humic substances, copper speciation to ma-rine waters, and equilibrium thermodynamics in trace element organographs. Jovited speakers are 8. Ifying, II. deBaar, M. Perdue, A. Hanson, and F. Boyle.

Comparative Estimates of Chemical Fluxes Across the Sediment-Water Interface Friday A.M., Room 317. The invited talks in this session are as follows: 'Entrophication and Rates of Bembic Organic Matter Mineralization in a Coastal Marine Faosystem," by S. Senzinger: The Role of Nitribeation and Demirification in Estuarine and Coastal Sediments, by W. Kemp, R. Twilley, M. Jenkins, J. Stevenson, and W. Boymon; 'Recent Measurements of Benthic Fluxes in Delaware Bay, by C. Culberson, S. Guest, and J. Shrap: Comparative Estimates of Trace Element Fluxes from Sediments of the Delaware Estuary, br T. Church, J. Schudlark, J. Tramontano, and C. Lurd; 'Nurrient Regeneration and Oxygen Consumption by Sediments Along the Salimity Gradient in Chesapeake Bay, by W. Boynton and W. Kenip; and Comparison of In Situ Nutrient Flux Rates in Adjacent Subesmaries of the Chesapeake Bay, hy B. Landtrip, L. Callender, and B.

#### Planetology

Achondritle Meteorities From the Moon or Mars? Monday all day, Room 305. Recent analysis of unusual meteorities, most of which are from new Antarctic collections, indicate that some material falling to earth from space has origins from planetary-size objects, namely from the moon and possibly from Mars. Five years ago such a thought was treated as an interesting but unlikely hypothesis. The current geochemical, petrological, and dynamical data to be discussed in these special sessions make the case rather compelling for meteorites from the moon and at least strougly possible, if not likely, for meteurites

#### Seiamology

Solar Seismology Monday A.M. Reinn 321. Seismology is cosponsoring this session with SPR: Solar and Interplanetary Physics (SS)

Note: Oo Monday alternuon and all day Tuesday, coordinated scheduling between the Selsmolugy (S) and Tectonophysics (T) sections will bring 3 half-days of consecutive sessluns, covering such topics as Ridges & Convection (T), Subduction (T), and Ocean Margins Seismicity (S), which will emphasize the close links between the two sections.

Seismology and Volcanism Wedgesday
A.M., Ruom 320. Cosponsored by the VGP section, this session will have papers on the: characteristics and identification of volcanic earthquakes, seismic mapping of volcanic edifices, and theoretical modelling of cruptions as scismic sources.

Verification of Nuclear Test Bans Thursday all day, Room 317. The Seismology section is cosponsoring this Union session, featuring talks on yield estimates and discrimination (see Union, above).

lan .

Attenuation and Fluid Interaction Thursday P.M., Exhibit Hall A. This will be a joint poster session with T, with papers on Aneutuation Theory, Fluid-Filled Burehole Seismology, and Pore Pressure Diffusion.

Ocean Surveys and Intraplate Selsmicity Friday A.M., Room 321. This session concludes the Scismology program, and features papers on the investigation of the oceanic plate at shallow depth using refraction methork and deeper prohing of the lithusphere from intraplate earthquakes.

#### SPR: Aeronomy

Atmosplicyle Electrical Environment Wednesday all day, Room 301. Cosponsored with Atmuspheric Sciences. In recent years there have been significant advances in our knowledge of lightning phenomenology and lightning physics; cloud physics thath microphysics and dynamics); cloud electricity; electrical processes in the boundary layer, middle, and upper annosphere; and tise global cirruit. Research in most of these areas has been pursued independently by people often in unally different scientific disciplines. The major jumposes of a current study being conthickel through the Geophysics Study Committee of the National Research Council are to review the advances made in each of these independent research areas, to examine the interrelationships that exist between these areas, and to project linw this knowledge can he amdied law the benefit of mankind. For example, invavurements of the EM signatures radiated by lightning clearly indicate that lightning ran rent risctimes are alimit an order of magnitude faster dam the present engineering test Mandards; and therefore major revisions in lightning protection methods may be necessary. These will be an attempt to project where significant new advances can be maile both in basic research and in application within the next deraile and highlight areas where new research is needed.

Incoherent Scatter Radar Studies of the Ionosphere and Atmosphere Thursday all day, Room 301. The session will comain over 25 papers on new results from all of the incoherent scatter observations. The session will include a special review talk by John V. Ev-

#### SPR: Cosmic Rays

Application of Cosmic-Ray-Produced Nuclides in Geophysica Monday all day, Room

310. The SPR: Cosmic Rays section, which usually deals with the physics and geophysics of cosmic ray origin and transport, has urganized this session to promote understanding of the interdependence between cosmic ray physics and its applications in other areas of geophysics. The histories of geophysical syslems as diverse as Arizona ground water, lake sediments, polar ice, manganese modules, corals, volcanic rocks, petroleum, and teknies are now being traced and dated with radioactive nuclides produced by the cosmic rays that bombard the earth's atmosphere. New detection methods for these nuclides pravide the improved precision and accuracy needed for older and smaller samples. Cosponsored by SPR: Magnetospheric Physics, Aeronomy, Oceanography, and Volcanology, Geoclicinis try, and Petrology sections. Invited speakers are J. R. Jokipii, E. M. Druffel, K. Nishizumi, S. N. Davis, K. K. Turekian, L. Brown, and

#### SPR: Magnetospheric Physics

CDAW-6: Substorm Energy Transfer 7 insday A.M., Room 310; Tuesday P.M., Exhibit Itali A. Coordinated Data Analysis Worksliops (CDA W) are enabling investigators with data from diverse instruments on various space craft to focus their attention on a few specific events of common interest. Results of the CDAW-6 effort will be mesented in a full ural session (Tuesday A.M.) and a small poster session (Tuesday P.M.). Bub McPherron (UCLA) will keynore the day's activity with an invited overview of the March 22, 1979, substorm event, which is the focus of the CDAW sessions. The CDAW process will be described in opening remarks by session chairman Bob Manka (NRC), who coordinated the workshops.

Numerical Simulation of Space Plasmas Tuesday P.M., Exhibit Hall A: Wednesday

P.M., Room 310; Thurnday P.M., Room 303. Three sessions un the magnetospheric prograns will feature methods of numerical simufatium. The six contributed poster papers (Tuesilay P.M.) include simulations of the how shock and whole magnetosphere, as well as simulations of specific wave modes in mattiral and experimental space plasmas. The three invited oral papers (Wednesday P.M., full-awing the 'Franciers of SPR' Lecture! provide a perspective on the general philosophy of plasma simulation [A. Flasegawa, Bell Label as well as specific applications to the magnetopause (P. L. Pritchen, UCLA) and

how slinck (C. C. Brioth jeh, Piny, of Mary land). The four contributed end papers (Thursday P.M.Luwer a similarly broad) scope. The three sessions on numerical sumation offer geographical breachle as well, in that many of the contributed papers describe work done in Europe or Japan, Cosponsored by SA and SS sertions.

Geomagnetic Tall and Boundayy Layer Tuesday P.M., Room 310; Wednesday A.M. Room 310. George Parks (Pniv. of Washingion) has organized two sessions of invited and contributed papers devoted to the genmagnetic tail and hornidary layer. Topics leatired include the magnetic-light configuration, charged-particle populations, plasma llow, ion composition, waves in the tail plasma and homodary layer, electric fields, and fundamental plasma theory. Also included in the program are two invited papers on the recent ISEE-3 ruconner with the distant portion of the geomagnetic tail.

Frontiers of SPR Wednesday P.M., Room 310. The Frontiers of Solar-Planetary Reationships' Lecture for the 1983 Spring Meeting will be delivered by Wallary M. Manheimer, a well-known plasma theorist with the U.S. Naval Research Laboratory. The will discuss the analytical and manerical methods that are used with success to rabulate sellconsistent ring-current models for laboratory plasmas. In view of the evident analogy hetween laboratory and planetary ring emirculs, a major goal of the british will be in histor the sharing of analytical and monerical techniques between laboratory-miented and space-oriented plasma physicists, so that each major branch of plasma physics may benefit from the experiences of the other. Carsponsored by SA, SC, and SS sections.

#### SPR: Solar & Interplanctary Physics

Solar Seismology Monday A.M., Room 321. The normal seismic printings of the simi with remporal periods from minutes to hours and spatial degrees up to 1000 have here observed. These provide information on the internal mass distribution and mulation rate and cunvection velocities inside the sun at various depths in a way similar or earth seismology. Observation and theories will be presented by NY 1006 F (911):350-2900 and H. Bongok E. J. Rhodes, Jr., J. Tinguire, P. H. Scherrer, T. L. Diwall, R. Ulrich, and H. A. Hill, Grsponsored by the SC and Seismology sertions. Magnetohydrodynomie Turhulence in

Space Thursday P.M., Room 310. This ses-

some will core the statistical behavior of the al solar wirel include mer, includence indig i those bysours made Bound happing we medicine and the dynamical equilibrium strained magnetic tickly it fraints miss bula is pr W. H. Aratherene W. P. Coll. som W. Carlobinio, and J. N. Paler, Co. sponsored be St. and SM stations.

#### Volcapology, Geochemistry & Petrology

Chemical and Isotopic Constraints to be drain Maginatism Vendae A.M., Rose 183 Presentations of petrologic and geodecical evolence bearing on relative toles of eq. nental crust, usuabe, and solubated data the petrogenesis of the photoic and who rocks of the Andes for further informate contact the convenors: Hathara Berreigh. partment of Terrestrial Magnetism Cargo Institution of Washington, 5241 Broad Branch Rel., N.W., Washington, D. C. 206! (202-966-0863) and Russel S. Harmon by of Grodogical Sciences, SMP, Dallar, TX

75275 (214-962-2750) Solubility and Transport Properties of Water in Silicate Melis Wednesda AM, B. 708 His ussions will include water contra in magnias, water solubility medels, soluband spectroscopic data on hydraus glass and meles, effects of dissolved volatile on physical properties of meles, and water desion in melts and glasses. For Innher me mation, contact the conveners: P. McMilla Dept. of Chemistry, Arizona State Units empe, AZ 85287 [G02-065-508]] and E Stopler, Div. of Geological and Planetan So ! emes, Cal Fredi, Pasadena, CA 91125@B 456465044.

Genchendent Heterogeneities in the Metle: Implications for Montle Convection Thursday J.M., Room 308. Isotopit, 900 chemical, and geophysical heterogeneitist the oceanic crust and related upper made and the constraints these may provide only spen procurees, convertion, and flow pages. in the mantle will be this ussed. Results from IPOH I rg 82 in the North Alkatic will be. cluded. For further information, contacts and J. G. Schilling, School of Oceanograph. Univ. of Rhode Island, Providenc, RI @ (101-792-6248), and D. L. Turcotte, Depos-Geological Sciences, Cornell Puly, Idao. NY 14865/007-256-5267).

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#### Aeronomy

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HIGS-LATHUDE EXCEPHERIC TEMPERATURE OBSERVED
OVER A SOLAR CYCLE

WER A SOLAR CYCLE
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in high-latitude accephants temperature desh over chass
poriods. These data are now available. This vary large
dasa been indicates that the high-latitude soutpharic
temperature valids distraily and semsonally as separate
seed by 180°K over this anier cycle. (Excepheric temperatary, solar cycle, high-intitude, auroral sone)

## Electromagnetics

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O705 Biological effects
PHYTOPLARFOR AND THEMAL STRICTURE IN SID HOPELS OF AND
CXISTQUENCES OF NON-UNIFORMITY IN CHIOSOGNILL FRObile.
It. R. Levis IMarine Ecology Laboratory, Bedford
Inasticute of Josenography, Partmouth, Boar Prolin
B2Y MA2), J. J. Cullon and P. Plati
Solar irradiance absorption in the upper tayors of
the ocean is influenced by the consentration of paying
planston. Bon-uniformities in verifical chiorophylic
(phytoplankion) distributions and to non-uniformities
in absorption and conceptently to variations in Joset
heating. Local heating rate tends to decrease monetonically with increasing doyth, but acrtain vertical
distributions of rhiorophyli tend to a change of the
station showed a subsurface assistance of chiorophyli Intessas caused to allow increases heating in the tipe of
alogy of the chiorophyli maximum, with a maximum gradiest of 0.00°C d<sup>-1</sup> T. It suggested that the faportance of such subsurface heating for augmenting
werlived align and influence and also layer decidently
werlived align and influence and size layer decidently
may be greened in the optically riser, alone occurs

J. Occyhys. Res., Graen, Psepr 101905

0770 RADIO OGGANOGRAPHY THE THO-SCALE RADAR HAVE FROM AND GAR IMAGENT OF THE

THE TWO-SCALE RADAR HAVE FROME AND SAR HAM-SPT - IT TIME COEMN
M. J. Plant (Environmental Sciences Civision, Maval Research Laboratory, Mashispton, DC 20375)
A Cud-scale formulacion of cananic backscattor of siccowave redistion, which has proviously lean significant to the two-scale redex wave probe and SAR insugery of the occase and the occase and the scale redex wave probe is a microwave system which coherently detects signals accutored from a very small patch of the occase surface. It is shown that a SAR image may be described as a convolution of the AM part of the occase surface. It is shown that a SAR image may be described as a convolution of the AM part of the occase surface. The SAR images are not faithful routed for the output. These SAR images are not faithful routed surface. Observed one court as a result of variable surface. Observed one court as a result of variable surface valorities court as a result of variable surface valorities. Examples of this distortion are desired from two-scale wave probe date takes in the Output of Maxico. Application of a focusing correction of a nearly sinusoidst, estimate-travelling yave. of a mearly sinusoidat, defauchtravelling wave. Large V/R<sub>o</sub> ratios minimize the distortion, however. J. Geophys. Res., Orean, Paper JC0481

U780 Scattering
AADAR CROSS SECTION OF A LIGHTHING ELEMENT MODILEO AS A
YLASHA CYLINUS
Y. Masur [Comparative institute for Massessia Metangological Scedies, The University of Olishoms, Forman,
Okiahoma 73019, E. Dovish
The refer Cross seatlan of a lightning element
wodeled se a finita length pissan sylinder at an
wodeled se a finita length pissan sylinder at an
oblique sogia of locidence is offered. The model is
hosed on the enset solution of Maxwell's squations for
a dialectric cylinder of infinits leagth. Assumptions
are ands about reflection and transmission at jostne
hetwean osighboring lightning elements. The proposed
model is relid for cylinders with radii that ere a
Red. fei., Yaper 360151

0705 Tropospheric propagation AN ORBITAL DIVERSITY ADDEL FOR EARTH TO SPACE LIMES UNDER RAIN AND COMPARISONS WITH SITE. OIVERSITY AVERSITY E. Matrictiani (Dipartimento di Elettronica, Politacnico di Miano,Piasza Leonardo da Vinci SZ

rolliscuico di Miano, Plasza Lemando di Electronica, 2013 Milano, Italy)
Biversity system are foresean for merch to sabei tite links operating at frequencios above 10 bic in localities with high rain induced attenuation. The paper discusses orbital diversity, shich though an analytical model for the rainful rainthough an analytical model of the rainful raindom process. The model uses rainguage enseurements and radar derived information at he stant abructure; it gives rasults almilar to experimental cats and physically machingful. A comparison is also carried out with corresponding sits diversity and the procedure for computing both elicans at the stant abruction absolute in given. It is shown that

orbital diversity may replace site diversity of far as rain attenuation is concerned and my give the same performense up to certain that geometry slich depends little on attenuation. It is also shown that site diversity gain and that the geometrical to orbital diversity gain and that the geometrical parameters is the separation and magic apertured which yield this conversion on related by linear celutionships, which are independent at inspirmey, faite diversity, outstail diversity, referencementation satellites, rathr afronsition). Ond, Srl., Paper Salaus

MAY: ANY KNIES, IF A MAY-CHIFOR TROPOSPER Alexander V. Enkunikh and Victor G. Signat (limit limit of Budiophysics and bloctroids, Andersy of Ectacon of the Chronias SS. Kneeks, Missis High).

Hunout direct manuscements of the repair vo index n of mir at different beights in a croposphere have misset that nimitateous and invested to 0,7-15 hm) invora with their periods in a not infraguent. Bush layers provide for the periods of mirration of mirit frequency electrosepship voo well beyond the optical horizon of captured to the theorem of the periods of the periods of mirration of captured to the control of the periods of the periods of periods to the optical horizon function of the periods of the periods of the control of the control of the control of the control of the period of the control of the period of the control of the period of the control of niquee). Rad. Sel., Poper ISOUII

## Geochemistry

1410 Chemistry of the Atmosphere CHLORISE HITRATE: THE SOLE PRODUCT OF THE CLE + Mg - 1 CHLORISE HITRATE: THE SOLE FRADUCT OF THE COLOR DATION
James J. Harylton [Jet Propulsion Laboratory, Critical
James J. Harylton [Jet Propulsion Laboratory, Critical
Institute of Tachuniogy, Panadena, California 1100,
The product of the CIO + NO; + N recombinations of
identified by using rancomes fluurescence to share
identified by using rancomes fluurescence to share
the contract of the CIO + NO; + N recombinations of the
mascent produced by 256 nm laser photolysis of the
mascent produced by Photolysis of aquirisers
to cattractions of synchetin chlorine afficts, strongly
gasting that nm other largery are formed in the reservance of the contraction of synchetic produced to the forward rate constant, which has been actualise of the forward rate constant, which has been accurated to explain on apportant decompany has been decompany to the constant of the produced of the contract of th J. Cemphys. Reb., Oyasa, Paper 300521

# Geodesy and Gravity

the model. The model relates crusted deforantion to the spicodic novement apparienced during targe sarchquekes (MS), mender alignets se goologic faults, and secular state rates over integ asgraphic areas. The uplactic screent fo modeled in securations with the theory of dislocation is an election halforece. For the secular ratio the modeled region to carifiliosed into a causal dislocation an an organic narropton. For the secal a notice the modeled region to partitioned into a social of distribute that are obligated to individually translate of distrible that are clieved in Individually translate, rictia, and baccessessly defere as a lieser function of time. The derived atrain paltors supports the typothesis that the modeled region spans has house the spothesis that the modeled region spans has not in which is serious plate benefary. Socials about atrain is madem to the M direction paraifel to the amfor faults, and what strain rates decrease with distance from a grant term of the middle and is bounded on the week by the San Justice for all some and un the east by the southern statistics of the Soc indress fealt. To the court bits atrip converges in width anth the imperial fault. The souler soled by for a point car the fitty of San Magor sittly to the direction in 1704 to 50. This rete procides a rough estimate for the relative velocity between the facility and far the facility and the facility and far the facility and the facility

### Hydrology

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NIC Eroston and Sadimentalton Argable ity of Sediment Removal in a Semi-Ario Mateo-

HARLAGETTY OF SEDINEIT REMOVAL IN A SEMI-ARIS MATER-SHID NITHEAST. Gray (Department of Geography, Arizona Sinia thiersity, Tempe, Arizona, 85287)
Field and Soutemainy data From Mahmul Guich Matershed, as instrumented sami-grid drainage basin of approximately 150 tmd (57 mtc) is southwestern Arizona, she that Alia of the alluvium removed from the basin during a 15-year arcsion apisade beginning about 1938 was accevated from the highest order stream. The around of alluvium removed in the erosion apisade would have been educated a covering of about 4 of mil.6 injures the entire basic. The rate of sodiment removal during the erosion spisade was 18 times greater than the rate of present themnel sodiment transport. Production of sediment from slopes and channel throughput at present rates are approximately agond and refilling will not occur under present conditions. The channel forces left by the massive executation of sediment impose controls on the species distribution of tractive force and tools stroam power that rate removed storage of sediment likely in only a law restricted feetiens. Modero instrumented records of a decade or over provide an inadequate perspective an inag-term sections. Modero instrumented records of a decade or over provide an inadequate perspective an inag-term sections movement. (Croston, sedimentation, erroyos).

130 Gramadwater BÖGLPORATION OF PRIOR INFORMATION ON PARAMETERS ISTO SOMLINEAR REGRESSION GROUND-WATER PLOW MOBELS Fichard L. Cooley 18.5. Coolegical Survey, MRD, P.O. Cox 25046, MS 413, OFC, Genver, CO 802251 Pichard L. Cooley U.S. Caolegical Survey, WRD,
P.O. Sor 130th, NS 413, OFF, Ganver, CO 50273;
This paper investigates lactors influencing the
dages of improvement in estimates of persenters of
a conlinear regression ground-water flow model by
incorporating prior information of uninour reliability. Consideration of expected belavior of the
trepseton refutions and results of a hypothetical
modeling problem test so several general continuations,
first, if the permanents are properly stated, linearlied appressions for the mean aquers error indist in
partiable estimates of a monithear model will offen
below vary nearly as if the modal were linear.
Second, by using prior information, the MSE in propsity acade permaneter can be redured greatly over
the MSE of ardinary least squares estimates of
partmeters. Third, plots of revisated MSE and the
estimated standard deviation of MSE versus an auxilisty parameter (the ridge permanetar) specifying
the degree of influence of the prior information ou
regression results can halp determine the j-stontial
for improvement of permoneter cellpaces. Fourth,
proposed criverto can be used to make appropriate
chickus for the ridge permaneter and another parameter
specialing degree of everalt bias in the prior informariam. Fasults of a case actudy of Trackee Meadows,
1800-Sparks area, Mashou County, Nevada, conform
cloudy to the results of the hypothetical yrobios.
In the Trunber Readows case incorporation of prior
information did not greatly change the persenter
autimates from those obtained by ordinary least
squares. Econver, the analysis showed clust both
sets of astinates are more realistic than suggested
by the ctendard errors from ordinary Leant, squares.
[Parameter astruction, unal innear regreesion
codeling, groundwater Figur modeling).

Valua Roscour. Fes., Paper 3MO2PS

Valer Rosour. Res., Paper 3W02P5

AS AFFICIENT PINITE ELEMENT TECHNIQUE POR MODELING TRANSPORT IN FRACTURED PORCUS MEDIA 1. SINGLY SPECIES TRANSPORT V.S. Byrkhro, S.R. Lester, and J.V. Mercer (Geoframe, inc., P.O. Mox 2550, Reston, Va 22090) a natheastical model for passented for numerical stablein of colute transport in naturally

a natheoriesh undel for passented for numerical antheoriesh undel for passented for numerical atchains of solute transport in naturally distantial of solute transport in naturally on the dual-perosity contextual approach, and is accept of an all stantial or the dual-perosity contextual approach, and is accept of and factures. Bellie earlier dual-perosity transport nodels which rely on parollel fracture as anysticus, the present model is a unfilled model that sim has the facility to represent block. Its great (i.e., systems with suberingonal fractures) using a spharical idealization of anaria slocks. Two governing partial differential fractures are written for anute irresport in the fractures and diffusion in the perous certis blocks. These equations are coupled by axes flux torus liestages). An afficient numerical achees is presented for approchanting the governing transport squariors. The scheme effectively roshinus a two-discussions, operase—weighted, finite allerant approximation for transport for the fractures with a neadlenging of a special and another individual antrix blocks. Compling of the two approximations is a performed implicitly. The system of algebraic squarions are solved using sequential subtime algorithms designed cospecially for the cutorical scheme are checked by applying the needs to a muchor of test problems and comparing results and capable of producing railable results with a material archae is lound to be highly with the sun material archae is lound to be highly with the sun material archae is lound to be highly with the sun material archae is lound to be highly with the sun material archae is lound to be highly with the sun are relatively resum a pathal and temporal discretizations. Finity the writing of the sunfactured, yet realistic problem. (Finity eliminal land). ilmistion). Practured media, transport

Vattr Resour, Rec., Paper 340528

His (kunoff & Streamflow)
AUTOMATIC CALIDRATION OF CONCEPTUAL RAINFALL-RUNOFF WHELES THE QUESTIONS OF FARACTER CHRENCE EDGENING WHOLES THE QUESTIONS OF FARACTER CHRENCE EDGINEETING ACTUME SOLUTIONS OF FARACTER CHRENCE EDGINEETING ACTUME SOLUTIONS OF A STORE ACTUME TO STREAM THE STREAM OF THE STR erse Lessur. Res., Paper Twispi

3460 (Educati & Secondion)
estindeness and deservability of conceptual maintallregist model taracters; the terculation process
examined

VI) LE Komat Suple (Department of Systems Engineering Vi) at Komat Suple (Department of Systems Engineering Class Western Besarvo University, Clavelend, Ohio 44106). Many researchers have expressed concerns regarding the uniqueness of primater astimates for coorastual rainfall-manife (R-S) and als obtained through calification. Sector total so Soroughian, Gopta 1- Folion (1981) and Soroughian & Supra (1983)) have revealed that avec though atochestic patagetar acting-

tion techniques can help, the ptobform are not sli due to inefficienties in the calibration techniques used, but ate caused by the manner in which the medel is structurally formulated. Thus even when calibrated under ideal conditions (almostation arounded) in the uten impossible to obtain unique estimates for the firancters. If is possible to resolve this problem, at least in part, by appropriate coperateirtissicos of the particular model equations. In this paper the percelation equation of the soil polature accounting model of the Matlead Westher Service Giver Forcess System fix-masses, will be discussed. It is shown that a logical reparameterization of his equation can result in conditions that improve the chance of obtaining unique parameterizations. It is believed that those results have implications to other conceptual P-R models where similar approaches are used in the representations of the percelation/infiltration process.

Process.
Walet Pessur, Res., Paper 241892

3160 IPHALIFF & SEPREMETON)
EVALUATION OF HAXIMUM LIKELIHOOD FARAMETER ESTIMATION
TECHNIQUES FOR CONFESTUAL RAINFALL-HUROPP NODELS:
INFLUENCE OF CALEBRATION DATA VARIABILITY AND EERGIN 5. Sproading (Speciments of Systems Engineering & Civil Engineering, Cose Western Reserve University, Cleveland, Ohjo, 44106), Vijai Kunar Gupta, James Lioud Bulton Cloyd Pulton

Clovd Pulton

The success of an automatit calibtation procedure
is highly dependent on the choice of the objective
function and the nature (quantity and quality) of
data used. The objective function should be selected
on the hasks of the sicchesitt proporties of the arrors
present in the data and in the andel. Also, the data
should be chosen so as to contain se such valuable
information about the process as possible. In this
paper we compare the parfermence of two markets
likelihood outlander, the AME which assumes the
presence of first-languagements and presence of first-lag-nutctorrelated homogeneous variance ortors, and the BML whith assumes the presence of uncorteined inhomogeneous vations extracted to the commonly used Simple Lessi Squares criterion SLS. The model cellbrated was the soil molecule accounting onder of the U.S. Kationai Weather Service's SLS. The model calibrated was the sold molerure eccounting ondel of the U.S. Kational Weather Service's River Potecasi fysiam [SMA-MSRFS]. The results indicate that a properly thosen objective function can cohence the possibility of obtaining unique and conceptually restitate parameter osciotess. Furthermate, the sometivity of the cationation results to various characteristics of the collection and such as hydrologic variability and length, are substantislity reduced. Vatet Resour. Res., Paper 291890

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J199 General MODELING TRITIUM AND CHLOPIDS- TO TRANSPORT THROUGH AN MODELING TRITUMI AND CHEMPING TO TRANSPORT THROUGH AN AGMENIATED UNISOL.

7. Nhodi-Firms isoli Science Supariment, University of Florida, Schill, J. V. Biggar, M. Th. van Counciton, Y. J. Vigeraga, H. N. Solim, J. H. Davidson and U. R. Hisison Broakthrough curves of "HyO and "Science Stade Gaglegares of an long of the curves of "HyO and "Science Stade Gaglegares of an long of the curves of "HyO and "Science Stade Gaglegares of an long of the curves of "HyO and "Science Stade Gaglegares of an long of the curves of "HyO and "Science Stade Gaglegares of an long of the curve of the curves of the curve

was partitioned into mobile and immobile rapions. Convective diffusive solute transport was limind to the mobile-water region. Transfer of a trajer betwoen the two soli-water regions was assumed to occur at a fair proportional to the difference in tracer contentration between the two regions. Surption of 'Migo and 'Cl was chanidered to be an instantaneous linear and coversible process. The two unknown parameters in Model I and the lour untnown parameters in Model I were sailed by firting model predictions to the experimental date. Model I could only describe BTGs obtained from columns pached with sensil aggregates [0.1-i.mm] and lor displacements run of small fluxes [0.1 cs/ht], whereas Model II described all the BTGs wall. Paciel numbers P im Model II on scaused on each separate column were resentable processed. Indicating a linear relationship between the approve diffusion coefficient of and the mobili-pero-water velocity 'my. The fraction of anoth who mobile pero-water velocity 'my. The fraction of moli water that is oablie 0 and the nees transfer coefficient of were found to be a Cunction of the physical and riveries proportics of the precus madus.

#### Meteorology

1711 Chamical composition and chamical interattions UP THE OISTRIBUTION UP NTROCEN PIOSIGE IN TES HIGH LATITUDE STEATOSPHEPE Easan Solocom (Aeronomy Laboratary, NOAA, Boulder, Colorado, 803011 and Polando P. Carcio A time depredent two dimensional under has been used to study the behavior of nitrogen species in the atmosphere. The model employs a realdual anament distribution for the transport of the photochemical species, and this transport yields large column abundances for No. Th + NO + NO. Calculated seasons! and diurnal variotions in 30; are also shows to be comparable to observations, even at high lacticudes. The effects of departures from sometive symmetric flow on 30; abundance are examined, and found to be consistent with observations. J. Geophys. Res., Grave, Paper 103455

### Mineralogy, Petrology, and Crystal Chemistry

4899 General (Archest orest genesis)
EVFECT OF A KADRAN TERREFERIAL MACHA OCEAN OS
CHOST AND NAMILE EVOLUTION
Anns R. Eofesister (Division of Geological and
Flanctory Sciences, California Institute of
Technology. Pesadans. California 91155) Anna R. Eofasister [Mivision of Goobletcal and Vienetary Sciscose, California Institute of Technology, Pesedens, California 91155)
This paper proceeds a model for the thermal and chemical switchion of a global ages uses resided by logact boating during the rarth's secretion, Ossailed calculations are given for a net depth of 180 he for such meshar ploritic and peridoticia compositions. lopact heating during run called depth of 180 he for calculations are given for a neit depth of 180 he for end-meshar ploritic and paridoticia compositions. Application of floid occlamics and heat transfer priociples shows as a first approximation that the proximation that the obtained end of restloani systellisation accurring only on the botroe of the megna nome. The fractional orystellization sequence for the picricic model is 90 hm of sefice, overlain by 15 hm of ol-sp-gabbrosorile, and capped by 15 km of irm-rich learedleving whereas the peridotica sequence consists of 99 hm of denits, hersbergits, and understand organization of the following between the peridotic and appead by 16 hm of veroiscopabbrosories, Although subscidios occursation would educated as all, but the subscidios correction would educated as all, but the peridotic would remain latest due to, their atabla decity profits. The shearaing of the that is layers of the periodic ta would remain latest due to, their atabla decity profits. The shearaing of the fair layers is boddl knower, the amposition of the self-diagraf is model dependent. The cast likely campits for the self-dependent. The cast likely campits for the self-dependent.

similar to manila monoliihs, suggesting that a terrestrial mages occan may have existed. However, comparison of the chamter; of the calculated upper falsic layer with that of the Canadian shield shows that drystallisation of a global mages occan would no directly produce the Archean tentinents crust. Multiple maining and differsoliation of the Poleucodiorfu to Releucoglobbronolita layer and of the underlying prioliton manile would be required to form an Archean genitoid crust.

J. Geodings, Sen., Red. Pener 180640

#### Oceanography

4710 FBesical Oceanography Intlumnce OF THE ARCITERRANEAR OUTSLOW ON THE ISOTOPIC COMPOSITION OF HS IN SATERS OF THE HORITH ATLANTIC The legislet composition of modymium in the water column of the eastern Morth Atlantic near the Strait of Obrailer has been determined for several depine. The data show that the Mediterranean outflow results in a data show that the Mediterranson outflow results in a significant whit in Engl(1) toward more radiogenic values of \(^{14.84}\) high in the water column at a 1000 mater depth. This corresponds to a depth in the melighborhood of the well-still wax man esseciated with the Mediterranson outflow. The core of the Mediterranson outflow gives \(^{14.01}\) = -9.8 as compared to \(^{14.02}\) \(^{14.01}\) = -9.8 as compared to \(^{14.01}\) \(^{14.01}\) = -12 in overlying and underlying waters, demonstrating that the Mediterranson waters are distinct from the Atlantic from mixing considerations, we called to the pure Mediterranson waters have \(^{14.01}\) = -6. Possible soutces of this relatively radiogenic Me could be from drainage of young continental intranses or the injection of rambbinated 8d from deep-sea sediments having a young radiogenic volcacic component. New data from a depth profile in the western Atlantic is presented. Comparison between 8d data for the eastern Morth Atlantic with the western Bearth Atlantic is presented. Comparison between 8d datas for the eastern Morth Atlantic with the western Bearth Atlantic is presented. Comparison between 8d datas for the eastern Morth Atlantic with the western bearth Atlantic is presented. Comparison between 8d datas for the eastern Morth Atlantic in the western bearth atlantic is presented. Comparison than the western bearth at a decrease of the eastern bearth at a decrease of the forth Atlantic (-1000 on have the lawest values of the forth Atlantic (-1000 on have the lawest values of the forth Atlantic (-1000 on have the lawest values of the forth Atlantic (-1000 on have the lawest values of the forth Atlantic the Arctic Ocean or from the Injection of '1016'' continents. We be a lawe that the source of these low \(^{14.01}\) of the Precesbrian shields of forth Aserica and Asia into the Arctic Ocean or from the Injection of '1016'' continents. We will see that the source of the and lajection of the first transport processes from Atlantic and laster transport processe significant shift in a<sub>Hd</sub>(0) toward more radiogenic val-ums of <sup>142</sup>dd/<sup>154</sup>Nd in the valer column at a 1000 meter

4720 Cistributions and Water Resease

FPACTURE ZONE S. L. Eltretm IV.S. Geological Survey, Menjo Perk, Catifornia 940251, P. E. Siscaye, and Stanley S. Jacobs
The Veps Fracture 2-ne trough, at 11°N between 41° and 45°8. Is open to the west a the 5000-2 level but is silled at the 4850-2 level on the east where it intersects the asset of the Hid-Ctientic Pider. The trough are of the Mid-Crientic Piden. The trough is filled with Antarcia Income data; (ACBV) with a potential temperature of 1.12°C and salinity of 34.82 ppt. The hottor water is thereally well as land in a meanity homogenous jayer about 730 m thick. The great thickness of this bottom javer, as a meaned with the bottom water structure if the season Ctlantic basis, may result from schanced mixing induced by topographic construction at the west and of the fracture some trough. Committee therefore the fracture some trough. Committee the meaning of the fracture some trough. Committee the meaning of the fracture some trough. It is associated with an about 1.2 using milling with depth at about 1.2 using milling with depth at about 1.20 meters show home home. A remainional lawer of more positively trapperature justants about 5.00 meters show home home. Thereta, temperature distinct, about 0.4 males in lieu hatween the Penthic thorsecite above and the Acew below. The CAN layer whose depth-averaged suspended partiquiste concentrations range from \$ to 19 mg t in its consistently higher in turbidity than the overlying waters. At the eastern and at the trough, 140 m delow still depth, wary low borcheastward current velocities, with maximum of 1 cm si, were recorded for an Jiday period. thousand mater, ocean turbidity, bolcom currents, miximg!

J. Geophys, Res., Oreon, Paopr 201986 4165 Surface wares, Lidet and see lavel Tides On THE NORTHERN GREAT BARRIED DEEF CONTINENTAL SUILLY SULLT
t. Woldneki (Austrelien Institute of Marine Scimete,
PMS No 3, Townsville, Q. 4810 Australis].
See level and current date are seed to show that, SI
least for the dominant smel-durnet tides, the northern
Great Barrier Reef is permedia to tides, the longshore
gradients of the phese end amplitude of the tide of the
sholf breat are zery swall, and the lide turrents are
controlled by the shelf bathymetry. The built friction
to efficient may be methanced by the secondary circulation
around card reads - [Tides, lids] currents, Brost
Observer Graf, Friction]

### Particles and Fields— Interplanetary Space

PRODUCTION OF AURORAL FORE & REGION IRREGULARITIES ST PRODUCTION OF AURORAL FORE & REGION IRREGULARITIES ST POWERFOL & HINTHON P.S. Hibberd (Mex-Planck-Inglitur für Agronomia, 1411 Kaliechurg-Lindza 1, F.H. Garmany), S. Elelena, P. Stubbe, S. Kopha and H.T. Riscweld Froduction ol locuspheric one ceter Brragularities in the success rose 5 region by high power Inouspheric in the success rose 5 region by high power Inouspheric in the success has been bearing by means at the STARE auroral radar. Irregularities were produced at night, on eight oreasions using an I occas heating wave and on two creations using an I mode heating wave. The growth rise of the Irregularities is found to he sprentmeraly 30 s. the Irregularities is found to an approximately 50 s. Several physical possibilities to expless these ffed-lags are dispessed, and a mechanism is maggrated which is closely related to Seta's mechanism of quist assoral ero formation. J. Geophys. Res., Blue, Yaper 180522

0340 Shock wares
MAYES DESERVED UPSTOEAM OF INTERPLANETARY SHOCKS
O. F. TRUTUERS and E. J. Swith (Jet Propulation
taboralory, Californie intilute of Cathology,
6300 Oat Grevo Urive, Patedons, CA 91109), D. E.
Jonet (Orighan Young University, Phytics Seperteent,
Provo, Ulab 84601)
The properties of waves with frequencies below 3 Mz
observed upsirese of low Math number (2-3) interplanebry shocks are distanced. Migh frequency emissions
(0.2-2 Mz in the speceraft tream) are commonly detectal immediately upstream [c] Rg] of the shocks, whereas lower frequency emissions [-0.05 Mz] are found
to ectend upsirese to each greater distances (typically)
10 9a]. Onthe selections are right-hand circularly or
elliptically polarised and generally propagate within
a 15° consumple ratellire to the emblent magnetic. Field.
The lack of a significant compressions! component for
either of these waves is in spreement, with propagate within
parallel to the emblish magnetic field. Upsirace waves
are detected principally in association with quariparaled ebocks (Eg. 65°). Associated with quariparaled ebocks (Eg. 65°), associated with quariparaled ebocks (Eg. 65°

ruied out due to the observation of parallel propaga-tion of the waves. The most libely source to 1-10 keV cycleiron-essenth lone propagating away from the shock. The upsiream waves bear many similarities to those ob-served in the Earth's foreshock. The frequencies, poserved in the Earth's foreshock. The frequencies, polarization, and typical upstream elant are observy identical. It is also doduced that the lower frequency waves of both regions are generated by toy lane streaming away from the shock. There are some differences, however. Moves upstream of interplanatory thocks are found to propagate parallist to the regnetic field (15°), are non-corpressive (20% 0.25) and are quarently lower in emplitude. Additionally, there are extraordinary interplanatory events, for which the scale of the apstream wave region is greatly extended (-1300 Rg or 0.04 AU) and the field tates on a norm tarbalent character. The failer events should be of interest in modeling fermi accolaration of lons of collisionless shocks.

J. Goophys, Rus., dlue, Paper 140490

5170 Soler wind magnetic fields OVBANICAL SVOLUTION OF INTERPLACETARY RIGHETIC FIELDS AND FLOWS BETWEEN 0.3 AU ABS 0.5 AU: SWITEAUMERT

Observed Solution of Interplacetary Research Solutions of Streets U. 3 Au Ass U. 5 Au: SWIRAIMENT L. 7. Surings 1885A/GSFC, laboratory for Extratorisation Physics, Greenbelt, ND 207711 8. Schwenn and H. Besunbawer
The radial svolution of interplacetary flows and assumiated objects from Helica I and Yoyager \, respectively. During a 70-day interval in 1880 Wyager I observed two sireses which appeared to he recurrent and which had istill fine structure. The corresponding flows chastwed by Helian I were much ourse nouplar, showing sumerous cosil sireses, transient flows and shocks as well as a few large corotaling streams. It is suggested that in moving to 0 AU the largest corotation and/or corotaling streams and/or corotaling atreems and/or corotaling atreems and/or corotaling atreems in and shocks into a relatively thin region in which they empleaded to fore a single iarge-supliteds coupression wave. We refer to this isrgs-empliteds compression wave. We refer to this combined process of sweping and coaledcence as matrisement. The resutting fargs-smp) touch compression wave is different from that formed by the pression vevs is different from that formed by the steapening of a corntating stream from a coronal hole, because different flows from distinct sources, with passibly different composition sed magnetic polarity, are brought together in form a single new atrustura. As a result of entrsionant, senory of the anuress and flow configurations near the sun is lost. Scall-nois features are erased as the flows quow outward and anergy is transferred from anall scales to large sosies by entrsineed. Thus in the outer soinr ogsten the atrusture of the mainr wind only a sominated by large sosis pressure weres locopressions followed by rerefactions; separated by several AU. Beyond several AU most of the compression waves are no longer driven by atromes, sen the compression waves are no longer driven by atromes, sen the compression waves are no longer driven by atromes. Sen the compression waves are no longer driven by atromes, sen the configuration of the compression waves are no longer at the configuration of the compression waves are no longer at the configuration of the compression waves are no longer at the configuration of the configur

#### Particles and Fields-Ionosphere

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COMPETED FOR THE OF SHIRRING AND PROPAGATION
Dennis 1. Pumps, "Ministan Rose such Corporation,"
AN state Street, P.D. Drawer 719, Santa Marbars,
-distorate 94022.
The quadratic approximation for the phone structure
function to made to obtain the two-tre-points motival
coherence inaction If An, AD for aphorical wave
propagation through a finite with with transmitter and
receiver idented to framespace on opposite as less of the
slab. Concert analytic solutions are derived for two
cases, in the first case the random slab is represented
by a sme-themsional power spectrum of alectron density
fluctume come corresponding it propagation through
elongated transgularities as would scent for an
equatorial satalists into the ground station, in the
second case the random slab consists of isotropic
lonization irregularities. Both cases taken tagether
represent the seriemes of the range of results to be
empected for propagation through ionospheric
fluctuations, solar wind fragularities or instantion
that between the constant of a solar instantion

Furtherious solar wind frregularities or instantion

For both issue the complex peneral instant, results
are sightled by use of the thin phase-acress
approximation to obtain useful snattet, expensions for
fire vail as the resulting impulse response function.
It is shown that the impulse response to a fransatiled
power deirs function reduces to an exponential form to
the light of strong diffraction and to a Gaussian form
in the geometrical optics limit. The Gaussian form
in the geometrical optics limit. The Gaussian form
corresponds to pulse wander while the exponential form
corresponds to pulse wander while the exponential form
arrangeder of diffractive expressing powers of the
multipath affects. The relationship between the
generalized power opertrum and the impulse response
function is given and results are presented for the mean
that delay and lime delay litter. We accurate of the
thin phase-acress calculation of these quantities is
investigated in decalt. Identification, time delay
litter!

Red. Sci., Paper 350404

#### Particles and Fields-Magnetosphere

57% Hagnetotell (Equilibrium Structures)
SELF-CHSISTENT MAGNYTOTAIL TRIGET: EQUILIBRIUM STRUCTURES INCLUDING ARBITRARY VARIATION ALONG THE TAIC AXIS
Wollgamg Swingmann (finition for Theoretische Phy-alk, Ruhr-Universiche Bochum, 4b10 inchum I, Fed.

Rep. of Germany)
The meif-consistent theory of the quiet magneto-Hep, of Germany)
The self-consisions theory of the quist magnetoial is extended to two-disensional static equilibrium configurations with arbitrary variations in
two cartresias space disensions, for the case of
deglights pressure soluctropy and stati pleams
flow velocities, self-consistent theory leads to
a non-linear equation, which is solved numerically
and ensighteelly far several special cases. To defles conditions, we use the veakly two-dimensional
magnetotal theory by Him at al. 11973) to fit the
tail regulation be entire magnetosphers. We investigate the influence of boundary conditions and
find that small changes of boundary values cause
the equilibrium to form entilitary structures with
ungnotir leiseds in the pleams sheat. This model is
able to explain structure observed in the quiel
ungnarotal as equilibrium phonomese. Ossides these
tail-like solutions, there waists mother class of
equilibria which is stable against all two-dimensional potturbarions. These solutions have one neatral point, thay contail less morety than the taillike salutions, the difference of energy boing of
the same arder as the energy releases in a tegantospheric substoem. (magnetocall equilibria, magnetospheric substoem. (magnetocall equilibria, magnetospheric plasma-sheat).
J. Geophys, Rau., Bloe, Paper DAOSJA

Lospheric plasma-sheat).

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ELEGYEON CURRENT GISSOTTION AND PARALLEL
ELEGYEON CURRENT GISSOTTION AND PARALLEL
ELEGYEON CURRENT GISSOTTION MITS BLECTROSTATIC ROB CVCLOTRON NAVER
A. J. Lang and H. Joshear (Physica
Department, University nf Gailforola Irvine, Irrine, Californie 92717)

Ohervations are yeasocted comearning
correct drives sicotrostacte los mysicireo
(EIC) waves produced in a colitalosies,
highly focised laboratory please in which
buth lon and electrons are magnesised. An
alactrostatic scalyses is used to show, for
the first time, afgalfizeou electro lium
diverpation by the potentials well of leaga
amplitude SIG waves; this effect has be
interpreted as trapping of she alastrone.
Eslationships between measured values of the
lon density flogspations (Go/n), normalised
wave posactials ind/Tg end the dagrae of
sleatron trapping agree with a sievim model
dagribing sicatron trapping to ica demsity
asviries. Associated with trapping of mora
than 50E of the sicctros distribucios to the
auterome of a weak electric field parellal
to the actrinel megnetic field and extending
axisily some thousends of Cobye leagths. The
significance of abase observations, with
partinalar reference to EIC waves,
the sacoral orasiaration wantenings, is
dianassed. (Laburatory, trapping, EIC waves,
passitst aleqtic fields).
J. Geophys. Ma., Cim., Vapar JAO463